

New additions to the cladoceran fauna of Ciénaga Grande de Santa Marta and Colombia

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ABSTRACT: Nine species of cladocerans are newly recorded from the Ciénaga Grande de Santa Marta Magdalena Department and of these, five of them are new to Colombia (*Dunhevedia crassa*, *Simocephalus vetuloides*, *Ilyocryptus paranaensis paranaensis*, *Nicmirnovius fitzpatricki* and *Coronatella monacantha*). The known number of Cladocera (45 species) in Ciénaga Grande de Santa Marta represents about the half of reported species in Colombia. Brief descriptions and illustrations of species, including distribution, are given.

INTRODUCTION

Freshwater Cladocerans are a diverse zooplanktonic group of Branchiopoda with about 620 known species worldwide. Around 30 per cent are Neotropical species (Forró *et al.* 2008). Colombia is part of the tropical American region and has two great basins: one draining to the Pacific Ocean, and the other to the Caribbean Sea. Located in the latter basin is the Ciénaga Grande de Santa Marta, which is assigned to the Peri-Caribbean region of Colombia (Hernández *et al.* 1992) where the major effort in cladocerans studies has been devoted (Pearse 1915; Camargo 1994; Gallo-Sánchez *et al.* 2009; Álvarez 2010; Aranguren-Riaño *et al.* 2011; Fuentes *et al.* 2012). In the Peri-Caribbean region the Cladocera family with most representative species is Chydoridae, which is divided in two subfamilies, Chydorinae and Aloninae (Dumont and Negrea 2002; Forró *et al.* 2008). It is represented by approximately 49 genera (Forró *et al.* 2008). The Chydorinae is a major subfamily of the Chydoridae (Smirnov 1996). Species of this family are specialized to inhabit littoral areas in aquatic ecosystems. The family Daphniidae contains six genera (Paggi 1993). *Simocephalus*, as all Daphniidae, is considered cosmopolitan (FADA 2012), inhabiting littoral areas and submerged aquatic plants (Orlova-Bienkowskaja 2001).

Despite increased interest in cladocerans, which are the object of new regional and local lists and several new records (Aranguren-Riaño *et al.* 2010; Fuentes *et al.* 2012), the knowledge of the cladoceran fauna of Colombia is incomplete and there is a need for additional taxonomic research.

This paper updates the list of Cladocera from Ciénaga Grande de Santa Marta by adding nine species, including five that are new to Colombia. Descriptions, distributions and illustrations are included for each species.

MATERIALS AND METHODS

The sampling took place from March to November,

2009 in southern Ciénaga Grande de Santa Marta, Magdalena Department, Colombia (10°52'11.25" N and 74°19'31.64" W). The Ciénaga Grande de Santa Marta is a great expansion of brackish water with an area of 450 km², and average depth of 1.5 m (Figure 1).

Samples were taken in the littoral areas with floating and submerged vegetation (macrophytes) and open water. Twenty liters were collected from open water at the littoral area. The sample, with vegetation and open water, was filtered with a zooplankton net (45 µm) and preserved in formalin 4%. The specimens were measured in lateral position, from head to the posterior part of the valve. Identifications were according to Elmoor-Loureiro (1997), Orlova-Bienkowskaja (2001), Kotov and Stifter (2006) and Elías-Gutiérrez *et al.* (2008).

Specimens were deposited at the Museo de Colecciones Biológicas de la Universidad del Atlántico – Colombia (UARC).

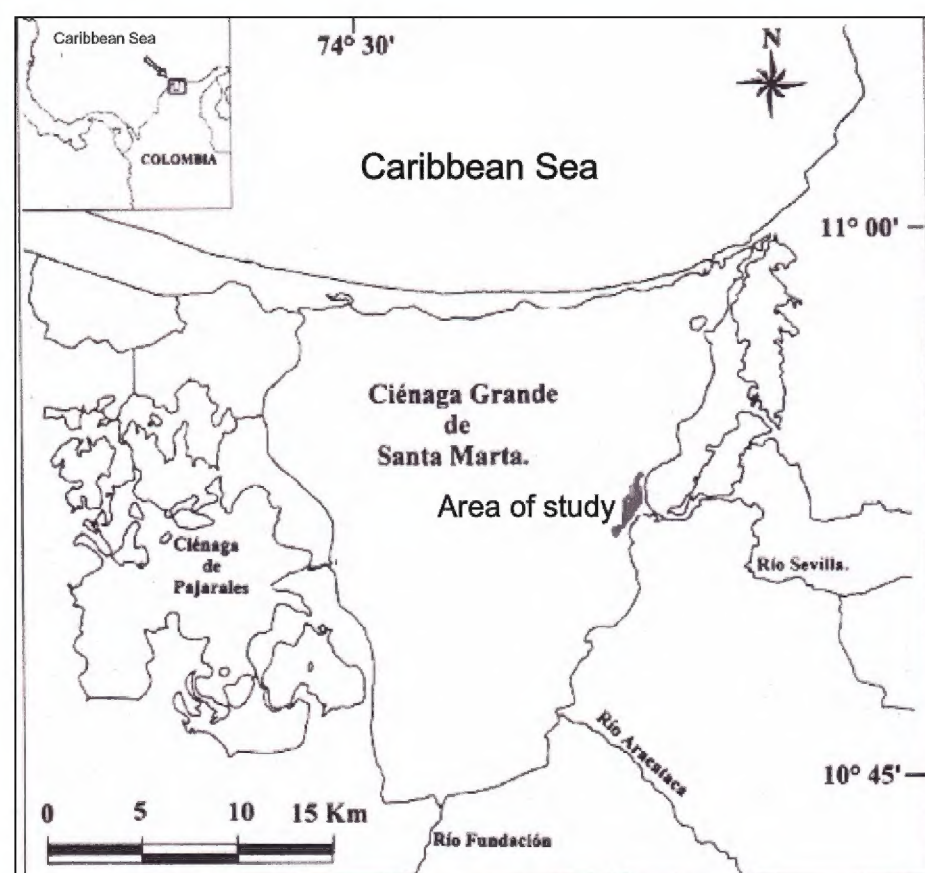


FIGURE 1. Map of Ciénaga Grande de Santa Marta.

RESULTS AND DISCUSSION

Thirty-six species of Cladocera were reported previously by Fuentes *et al* (2012) from Ciénaga Grande de Santa Marta. Nine species reported here are new records for this area, and five of them are new to Colombia (Table 1). These species are presented below.

Family Daphniidae

Simocephalus serrulatus (Koch, 1841). Synonymy in: Orlova-Bienkowskaja (2001):97; FADA (2012):37. Catalog number: UARC68M.

Oval body presents a triangular rostrum and short ocellus, frontal part of the head with denticles (Figure 2 A-B-C). Valve presents a protuberance and small denticles on its posterior end (Figure 2D). Postabdomen has denticles decreasing to proximal part (Figure 2E). Body length is 1.6 mm.

Differential diagnosis. Dorso-posterior valve prominence large, its length exceeding the diameter of the circle in its contour (Figure 2D). Postabdominal claw with spines on proximal part of outer side and on inner side and basal claw outer side without spines (fine setules present), with all setules of similar length (Figure 2F), and those features differentiate it from *S. semiserrulatus*.

Distribution. Elmoor-Loureiro (2004) found *S. serrulatus* in plankton; it is considered a cosmopolitan species (Orlova-Bienkowskaja 2001). Although previously recorded in Colombia from Antioquia, Boyacá, Cundinamarca departments (Gaviria 1984, 1993; Stingelin 1913).

Simocephalus vetuloides Sars, 1898. Synonymy in: Orlova-Bienkowskaja (2001):60. Catalog number: UARC67M.

The body is oval, elongated ocellus (Figure 3A-B) and depression on ventral head margin near rostrum deep. Distal portion of basipodit of antenna with a seta on outer side and spine on inner side (Figure 3C). The postabdomen presents 12 denticles, the distal ones are bigger and decrease proximally (Figure 3D).

Differential diagnosis. This species is related with *S. vetulus*, *S. elizabethae* and *S. mixtus*, but *S. vetuloides* can be distinguished from them by the long dorso-posterior valve prominence with less diameter than length, (Figure 3E). Dorsal valve margin not protruding backwards.

Distribution. According to FADA (2012) this is a Palearctic species. This is the first record for the Ciénaga Grande de Santa Marta and Colombia.

Simocephalus serrulatus and *S. vetuloides* were found only in macrophytes, although Elmoor-Lourerio (2004) found *S. serrulatus* in plankton samples.

Family Ilyocryptidae

Ilyocryptus paranaensis paranaensis Paggi, 1989. Synonymy in: Kotov and Stifter 2006. Catalog number: UARC65M.

Valves with complete moulting, lateral horns, reticulation not visible, spinules on the inner margin of valves (Figure 4A-B). Posterior margin of valves with setae, each armed with a large sharp spine-like projection (Figure 4 C). Antennule two-segmented, proximal joint shorter than distal one with a short spine and a little depression (Figure 4D). Second segment exopod of antenna with a

spine, antennal formula 0-0-3/1-1-3 (Figure 4E-F).

Postabdomen bilobed, with a depression approximately in the middle, postabdominal setae two-jointed (Figures 5 A-B). Postabdominal claw long and large, slightly curved, on the distal dorsal surface with three fine setules not reaching the tip; two long basal spines, the proximal one being a slightly larger than the distal one (Figure 5 C-D-E). Limb VI semicircular with setules around it (Figure 5F).

Differential diagnosis. Valves with lateral horns and the margin of inner surfaces with spinules. *Ilyocryptus paranaensis paranaensis* can be differentiate from *I. paranaensis inarmatus* Kotov, Elías- Gutiérrez and Gutiérrez-Aguirre 2001 by the presence of the spinules at valve margin on inner surface and well developed denticles on the base of postabdomen.

Distribution. This is a Neotropical species (Kotov and Stifter 2006). In South America has been reported in Argentina, Venezuela, Brazil and Paraguay (Paggi 1989; Kotov and Stifter 2006; Frutos and Carnavalli 2008; Zoppi de Roa and Lopez 2008; Kotov and Elmoor-Loureiro 2008). This is the first record for the Ciénaga Grande de Santa Marta and Colombia.

Family Chydoridae

Subfamily Chydorinae

Dadaya macrops (Daday, 1898). Synonymy in: Smirnov (1974):339. Catalog number: UARC42M.

The body is oval, present a short rostrum (Figure 6A); labrum is long and concave medially with an elongated tip (Figure 6B). Some *Dadaya macrops* present a denticle in the posterior ventral angle of valve, and others do not (Figures 6C-D). Antennules are tubular (Figure 6E). Second antennae with setal formula: 0-1-3/0-0-3 (Figure 6F). The postabdomen is narrow distally (Figure 6G). Body length is between 0.3 and 0.5 mm.

Differential diagnosis. Both, eye and ocellus large and labrum as in Figure 6 B.

Distribution. According to Smirnov (1996) is a tropicopolitan species. It has been reported for Colombia in Córdoba and Santander departments (Barón-Rodríguez *et al.* 2006; Álvarez 2010)

Dadaya macrops has variations in the valves concerning to the presence or absence of a denticle in the infero-posterior angle as reported by Rajapaksa and Fernando (1982). For example, some specimens from other regions (*e.g.*, Sri Lanka, Philippines, and São Paulo Brazil) do not have denticles, but specimens from Paraguay and U.S.A have denticles.

Ephemeroporus tridentatus (Bergamin, 1939). Synonymy in: Frey (1982):243. Catalog number: UARC47M.

The body is quite round (Figure 7A). Labrum is triangular, with four denticles (Figure 7B), valves without denticles (Figure 7C). Second antenna with setal formula: 0-0-3/0-1-3 (Figure 7D); the inner distal lobe (IDL) of limb I with three setae, one short and two large. The outer distal lobe (ODL) of limb I with one large seta (Figure 7E), the postabdomen is elongated with two groups of postanal marginal denticles, both the proximal and distal with four denticles (Figure 7 F), the postabdominal claw is quite curved with fine pectens (Figure 7G). Body length is 0.22 mm.

Differential diagnosis: This species can be identified

by the relatively short and broad head shield. There is a single, large median pore only in instar I. Well expressed rostrum, labrum with four denticles and valves with two setae (Figure 7C).

Distribution. Considered a Neotropical species, it has been found in South America in the Orinoco basin, Venezuela (Zoppi de Roa *et al.* 1985; Rey and Vásquez 1988), and in Brazil (Smirnov 1996; Elmoor-Loureiro 1997; 1998). There is a record in New South Wales Australia that is considered doubtful (Elmoor-Loureiro 1998). It has been reported from Colombia in Córdoba and Santander departments (Álvarez 2010; Barón-Rodríguez and Gavilán-Díaz 2007).

Dunhevedia crassa King, 1853. Synonymy in: FADA (2012). Catalog number: UARC43M.

The shape is elongated, almost rectangular; short rostrum (Figure 8A). Labral plate without serrations (Figure 8B). The denticle at the postero-ventral angle of the carapace (Figure 8C). Second antenna with setal formula: 0-1-3/0-0-3 (Figure 8D); the IDL of limb I with three setae (Figure 8E), postabdomen oval with anus located on its proximal dorsal margin, the claw with serrations and basal spine short (Figure 8F-G), which are typical features of the genus *Dunhevedia* (Smirnov 1996). Body length range is 0.32 - 0.36 mm.

Differential diagnosis. Labral plate without serrations (Figure 8F).

Distribution. According to FADA (2012) *Dunhevedia crassa* is a cosmopolitan species. In South America, this species is reported from Venezuela (Rey and Vasquez 1986), Bolivia (Rey 1991; Meneses 1997); Richard (1987) reported it from Chile but did not figure it. *D. crassa* is reported here from the Ciénaga Grande de Santa Marta and Colombia for the first time.

Dunhevedia crassa King, 1853 is often confused with *D. setigera* Birge, 1879. Smirnov (1996) treated them as synonymous, but further studies are needed (Elías-Gutiérrez *et al.* 2008).

Subfamily Aloninae

Oxyurella ciliata Bergamin, 1939 Synonymy in: Smirnov (1974):605 Catalog number: UARC37M.

The body is oval and rostrum projected with a round tip, (Figure 9A-B). Labrum with rounded keel and ciliated (Figure 9C), the posterodorsal and anterior surfaces of valves have polygons (Figure 9D). Second antenna with spine formula: 1-0-1/0-0-1 and setal formula: 0-0-3/1-1-3 (Figure 9E). The postabdomen length is three times the width and shows 12 denticles decreasing proximally; the first distal denticle is small (Figure 9F). The postabdominal claw is quite curved at the end without fine pectens (Figure 9G). Body length is 0.35 mm.

Differential diagnosis. Labrum ciliated (Figure 9C).

Distribution. According to FADA (2012) *Oxyurella ciliata* is a Neotropical species. In South America it has been reported in Brazil, Venezuela and Colombia (Elmoor-Loureiro 1997; Zoppi de Roa and López 2008; and Álvarez 2010).

Nicsmirnovius fitzpatricki (Chien, 1970). Synonymy in: Van Damme *et al.* (2003):42. Catalog number: UARC66M.

The body is suboval, labral keel is naked and triangular, (Figure 10 A - B), valve without reticulations (Figure 10C),

antennules are tubular reducing the thickness at the distal part, with a long setule on it (Figure 10D), second antenna with setal formula 0-0-3/0-1-3 (Figure 10E), limb I: IDL with three setae and ODL with one seta (Figure 11A). Postabdomen presents nine denticles at the distal part long setules at postanal margin, the length is 2.17 times the width (Figure 11B-C). Postabdominal claw very long, its length occupies over 40 % of the postabdomen and basal spine begins about 5.6 mm from the base of postabdominal claw (Figure 11D).

Differential diagnosis. *Nicsmirnovius fitzpatricki* is different from all other known species of this genus by the long antennules, length of body is about 2.5 – 3 times as long as width, the elongated tip of labral keel produces a depression in ventral margin near apex (Figure 10 B), the presence of compound eye, epipodite and dimensions of postabdomen (Figure 11B).

Distribution. *Nicsmirnovius fitzpatricki* is found in Nearctic and Neotropical regions (FADA 2012) and has been reported in the U.S.A. (Chien 1970), Puerto Rico, México (Van de Velde *et al.* 1978), Argentina (Paggi 1979), Venezuela (Zoppi de Roa and López 2008) and Brasil (Vila dos Santos *et al.* 2011). This is the first record for the Ciénaga Grande de Santa Marta and Colombia.

In comparing *Nicsmirnovius fitzpatricki* from Colombia with specimens from Argentina (Paggi 1979) and México (Van de Velde *et al.* 1978), it is noticeable that valves of Colombian specimens do not present reticulations, and the postabdominal claw has neither setules on the dorsal board nor fine pectens. The postabdomen is compact, similar to the Argentina specimen. Those differences suggest that *N. fitzpatricki* could be a species complex. This argument was also proposed by Van Damme *et al.* (2003). According to Frey (1974) and Paggi (1979) they are often in lotic environments. Our specimens were found within the floating plants (*Eichornia crassipes*). This association was reported by Paggi (1979). They were probably dragged by currents of Sevilla River to the zone, but further investigation needs to be done to confirm it.

Coronatella monacantha (Sars, 1901). Synonymy in: Van Damme *et al.* (2010). Catalog number: UARC64M.

The body is oval, labral keel with a blunt apex and anterior margin with or without notch (Figure 12A-B); valves with horizontal striae and postero-ventral corner with single denticle (Figure 12C-D); postabdomen of moderate width, its length is 0.39 mm (Figure 13A). Postabdominal claw with fine pectens and the basal spine is 50% of its length (Figure 13B). The IDL of trunk limb I with two setae, both with strong denticles in distal part, (Figure 13C).

Differential diagnosis. It differs from other species of the rectangula-group by a strong denticle on the posteroventral corner of valves (Figure 12D) and a long postabdominal claw (Figure 13B).

Distribution. This species is considered a Neotropical species, but records outside Neotropics need revision (Van Damme *et al.* 2010). This is the first record for the Ciénaga Grande de Santa Marta and Colombia.

Coronatella monacantha shows variations on the labral keel with respect to the presence or absence of notch at the anterior margin; this fact was presented by Sinev (2004). At one side of the labrum there can be outgrowths (Soussa

et al. 2011); the postabdominal claw with fine pectens was not mentioned by Sinev (2004).

With these new records, the number of species belonging to the families Chydoridae and Daphniidae in the Ciénaga of Santa Marta increases to 39 and 24, respectively. The greater richness of Cladocera from the Ciénaga Grande de Santa Marta could be related to increased sampling effort and targeting of littoral areas with macrophytes with which these species are associated. This interpretation has also been offered by Elmoor-Lourerio *et al.* (2004).

The previous papers pertaining to Cladocera of Colombia reported 87 species (Stingelin 1913; Pearse

1915; Jaramillo and Gaviria 2003; Monroy *et al.* 2004; Barón-Rodríguez *et al.* 2006; Barón-Rodríguez and Gavilán-Díaz 2007; Gallo-Sánchez *et al.* 2009; Guevara *et al.* 2009; Álvarez 2010; Jaramillo and Pinto 2010; Rivera *et al.* 2010; Aranguren-Riaño *et al.* 2011; Fuentes *et al.* 2012). With our present report adds 9 species, resulting in a total of 45 species in the Ciénaga Grande de Santa Marta, which represents 48.9 % of the species reported for Colombia.

Until now, in Colombia the number of species reported is 92 (including the 5 species reported here). This value is very close to that from Brazil (113) (Elmoor-Lourerio 1997) and Venezuela (112) (Zoppi de Roa and Lopez 2008).

TABLE 1. List of Cladocera species reported to Ciénaga Grande de Santa Marta.

ORDER	FAMILY	CIÉNAGA GRANDE SPECIES Fuentes <i>et al.</i> (2012)	SPECIES REPORTED IN THIS PAPER
Ctenopoda	Sididae	<i>Diaphanosoma brevireme</i>	
		<i>Latonopsis australis</i>	
		<i>Pseudosida ramosa</i>	
		<i>Sarsilatona serricauda</i>	
Anomopoda	Daphniidae	<i>Ceriodaphnia cornuta</i>	<i>Simocephalus serrulatus</i>
		<i>Simocephalus latirostris</i>	<i>Simocephalus vetuloides*</i>
		<i>Moina eugeniae</i>	
		<i>Moinodaphnia macleayi</i>	
	Moinidae	<i>Moina micrura</i>	
		<i>Moina minuta</i>	
		<i>Moina reticulata</i>	
	Ilyocryptidae	<i>Ilyocryptus plumosus</i>	<i>Ilyocryptus paranaensis paranaensis*</i>
		<i>Ilyocryptus spinifer</i>	
		<i>Onchobunops tuberculatus</i>	
	Macrothricidae	<i>Guernella raphaelis</i>	
		<i>Grimaldina brazzai</i>	
		<i>Macrothrix elegans</i>	
		<i>Macrothrix spinosa</i>	
	Chydoridae	Aloninae	
		<i>Alona glabra</i>	<i>Oxyurella ciliata</i>
		<i>Alona dentifera</i>	<i>Nicsmirnovius fitzpatricki*</i>
		<i>Euryalona orientalis</i>	
		<i>Karualona muelleri</i>	
		<i>Kurzia media</i>	
		<i>Kurzia polyspina</i>	
		<i>Leberis davidi</i>	
		<i>Leydigiopsis ornata</i>	
		<i>Notoalona sculpta</i>	
		<i>Oxyurella longicaudis</i>	
		<i>Oxyurella tenuicaudis</i>	
		Chydorinae	
		<i>Alonella dadayi</i>	<i>Dadaya macrops</i>
		<i>Chydorus eurynotus</i>	<i>Ephemeroporus tridentatus</i>
		<i>Chydorus nitidulus</i>	<i>Dunhevedia crassa*</i>
		<i>Chydorus pubescens</i>	<i>Coronatella monacantha*</i>
		<i>Dunhevedia colombiensis</i>	
		<i>Dunhevedia odontoplax</i>	
		<i>Ephemeroporus hybridus</i>	

* New species for Colombia.



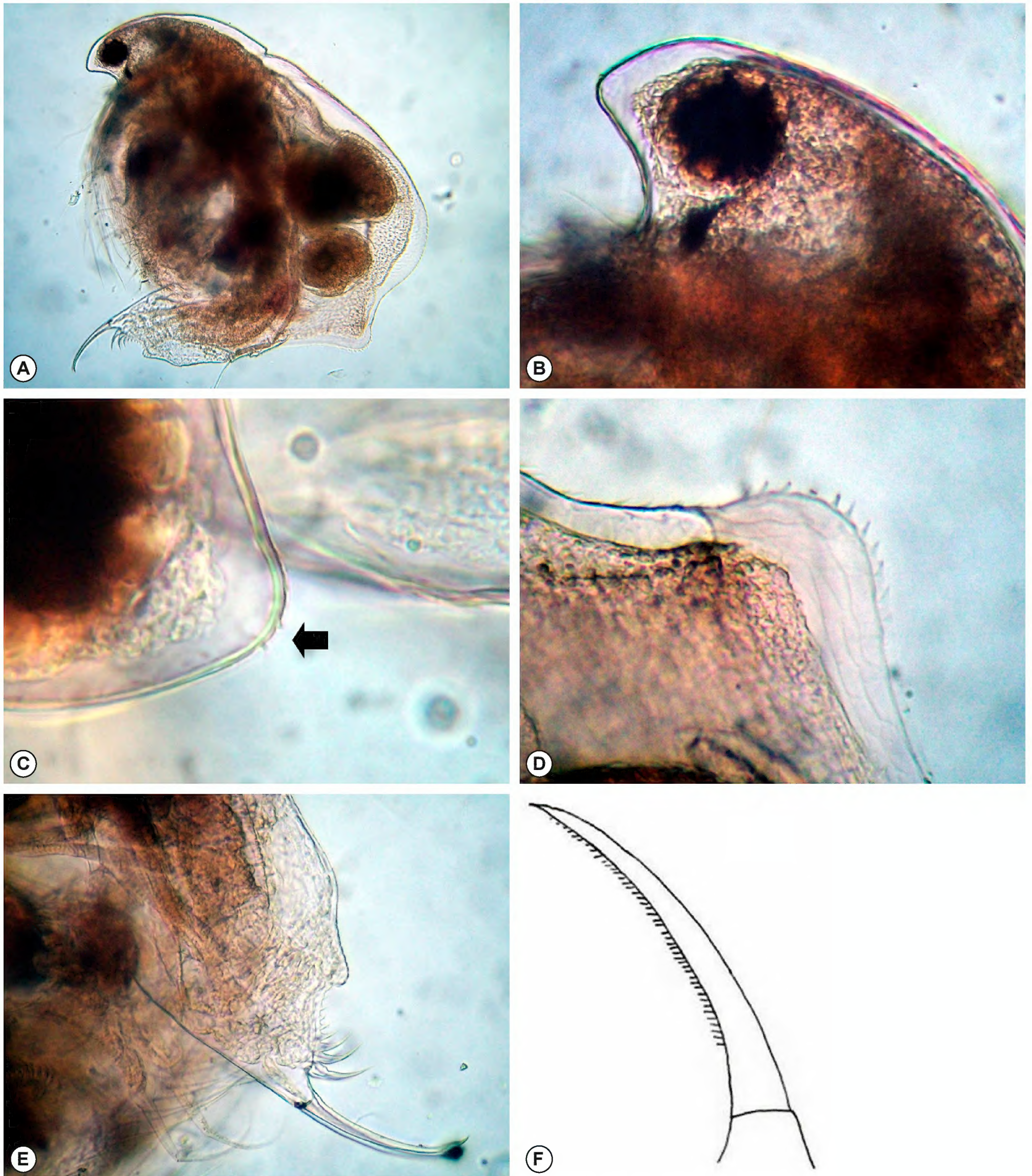


FIGURE 2. *Simocephalus serrulatus*. A. Adult. B. Ocellus. C. Frontal part of head with denticles (arrow points at denticles). D. Dorso-posterior valve E. Postabdomen. F. Postabdominal Claw (outer side).

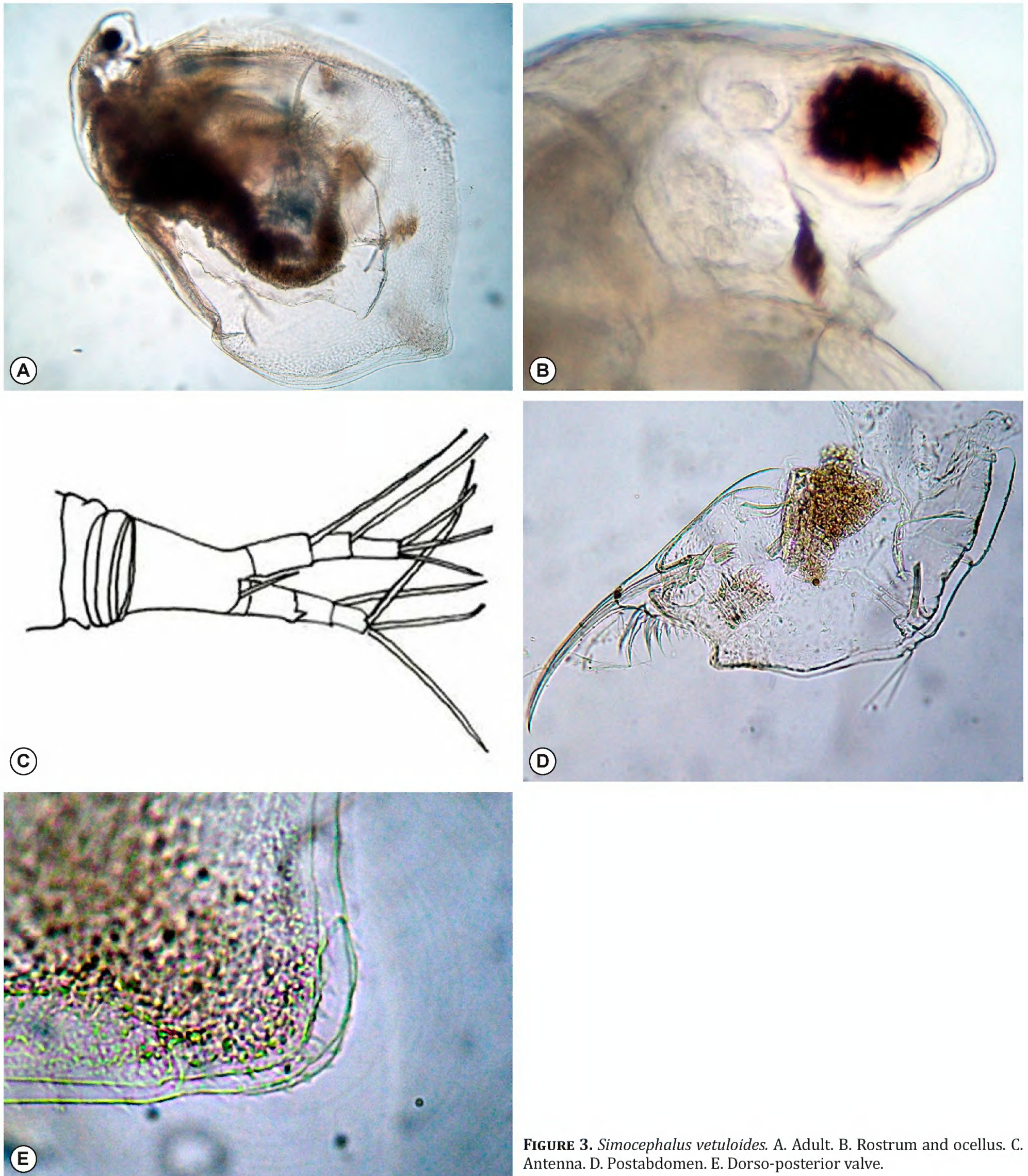


FIGURE 3. *Simocephalus vetuloides*. A. Adult. B. Rostrum and ocellus. C. Antenna. D. Postabdomen. E. Dorso-posterior valve.

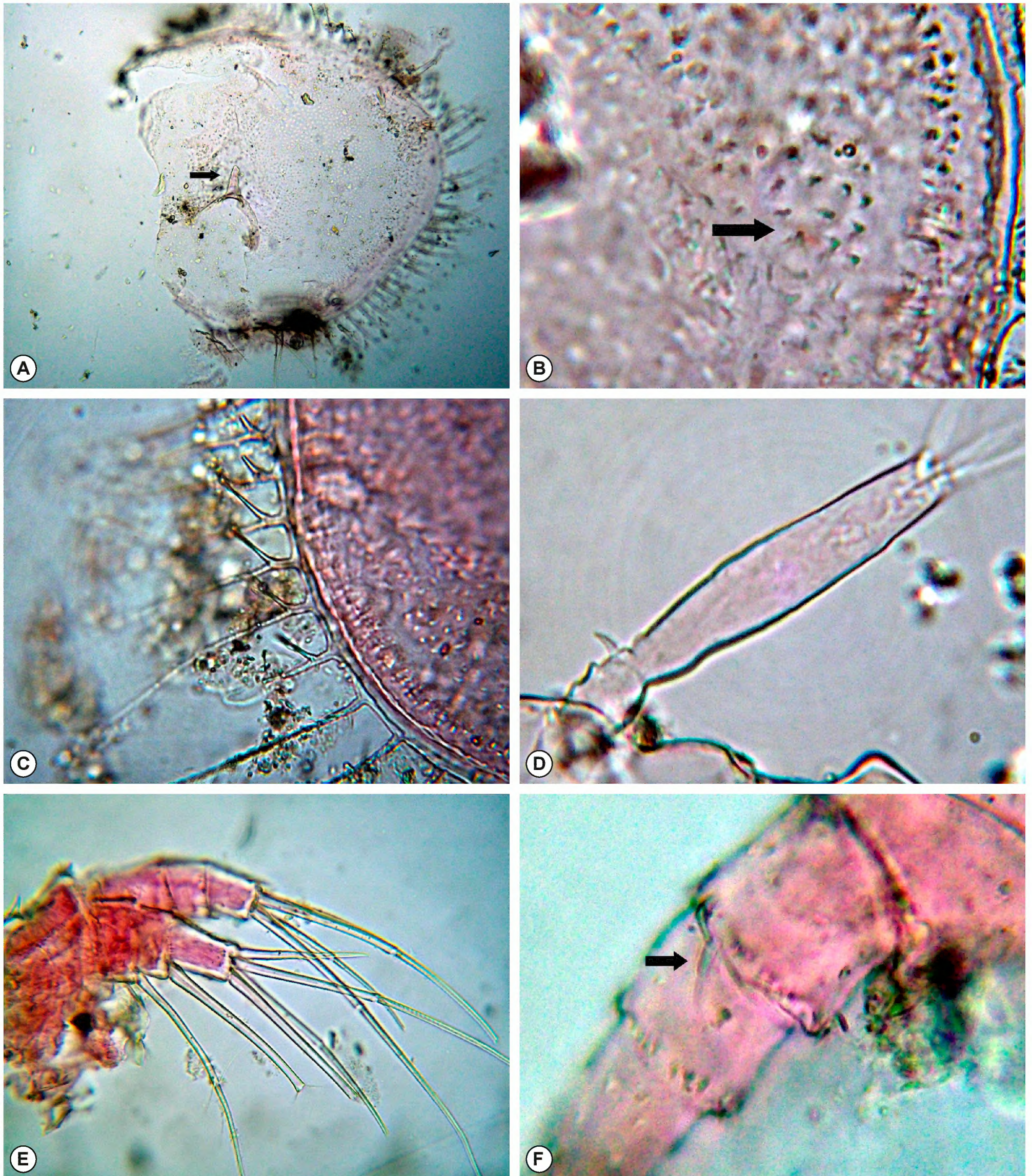


FIGURE 4. *Ilyocriptus paranaensis paranaensis*. A. Valve. B. Margin on inner surfaces of valve. C. Posterior margin of the valve. D. Antennules. E. Antenna. F. Second segment exopod of antenna.

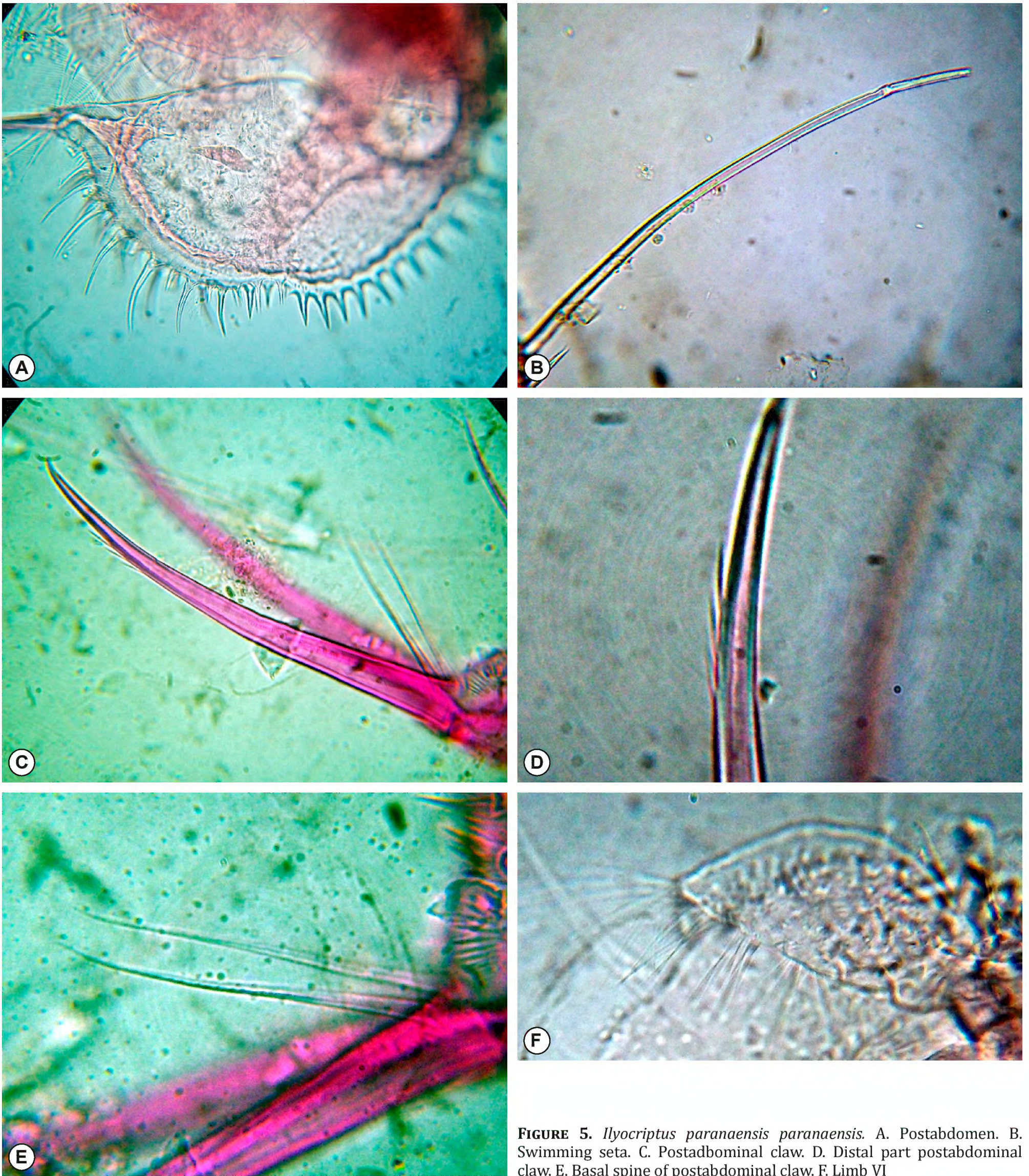


FIGURE 5. *Ilyocriptus paranaensis paranaensis*. A. Postabdomen. B. Swimming seta. C. Postabdominal claw. D. Distal part postabdominal claw. E. Basal spine of postabdominal claw. F. Limb VI

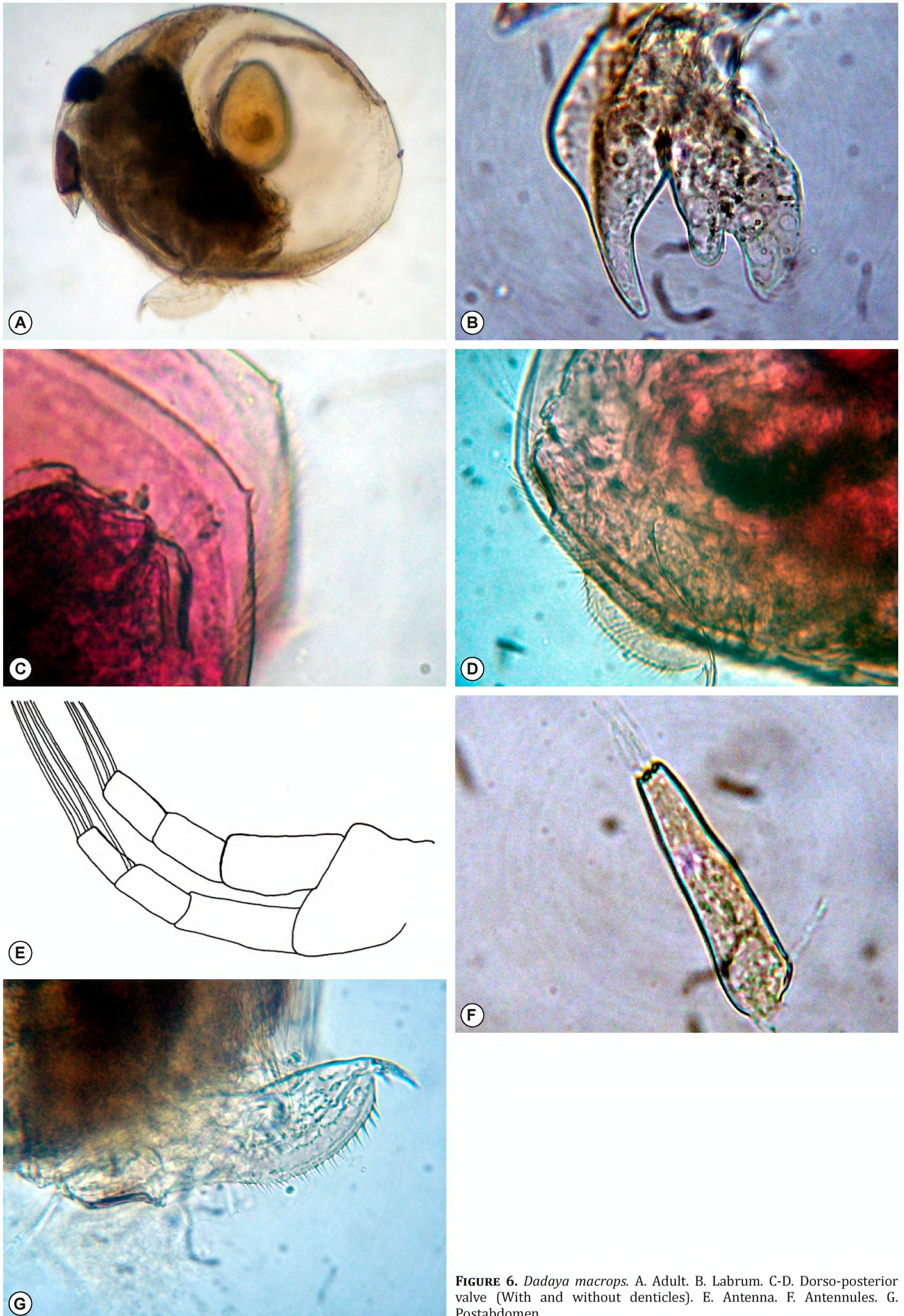


FIGURE 6. *Dadaya macrops*. A. Adult. B. Labrum. C-D. Dorso-posterior valve (With and without denticles). E. Antenna. F. Antennules. G. Postabdomen.

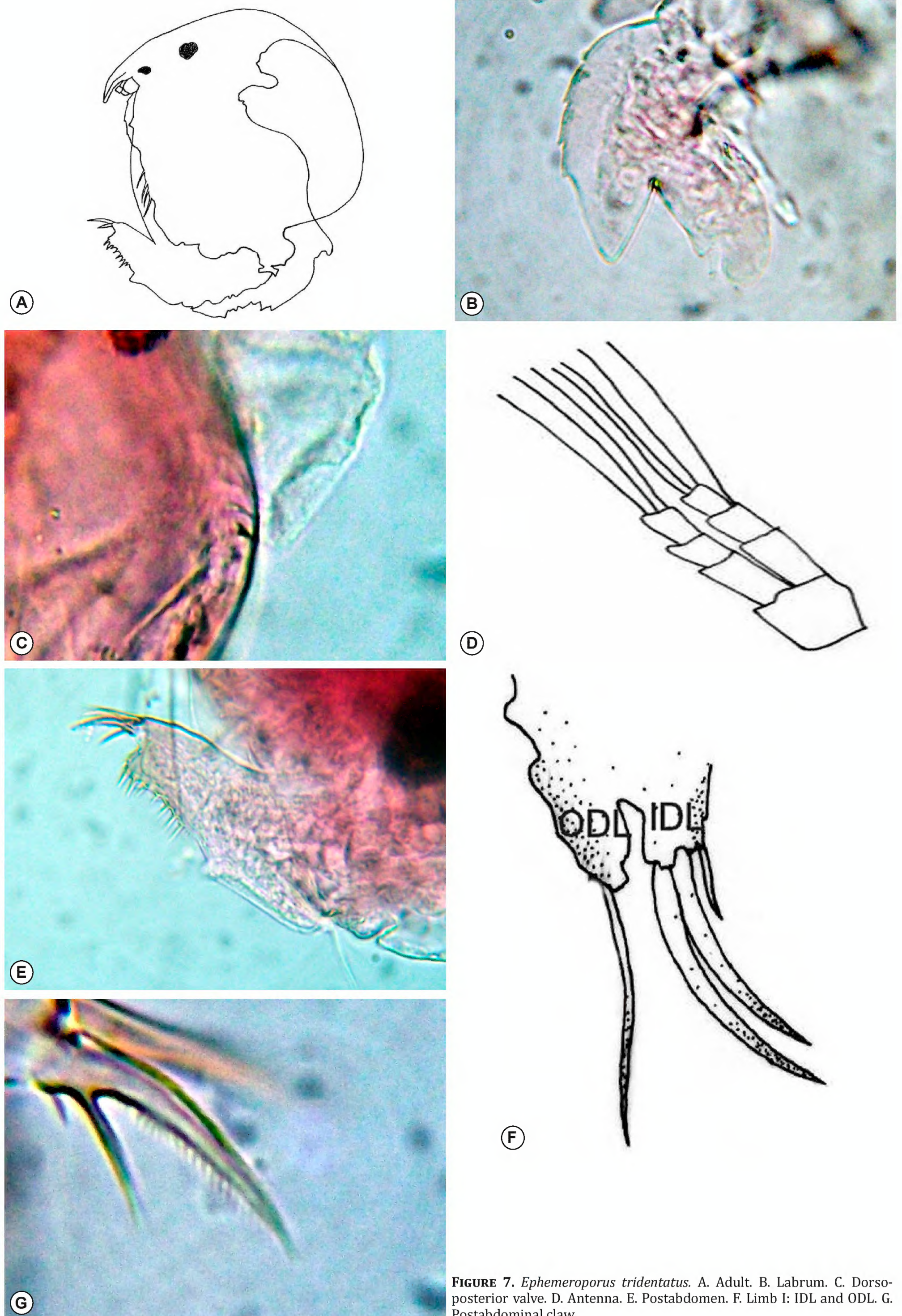


FIGURE 7. *Ephemeroporus tridentatus*. A. Adult. B. Labrum. C. Dorso-posterior valve. D. Antenna. E. Postabdomen. F. Limb I: IDL and ODL. G. Postabdominal claw.

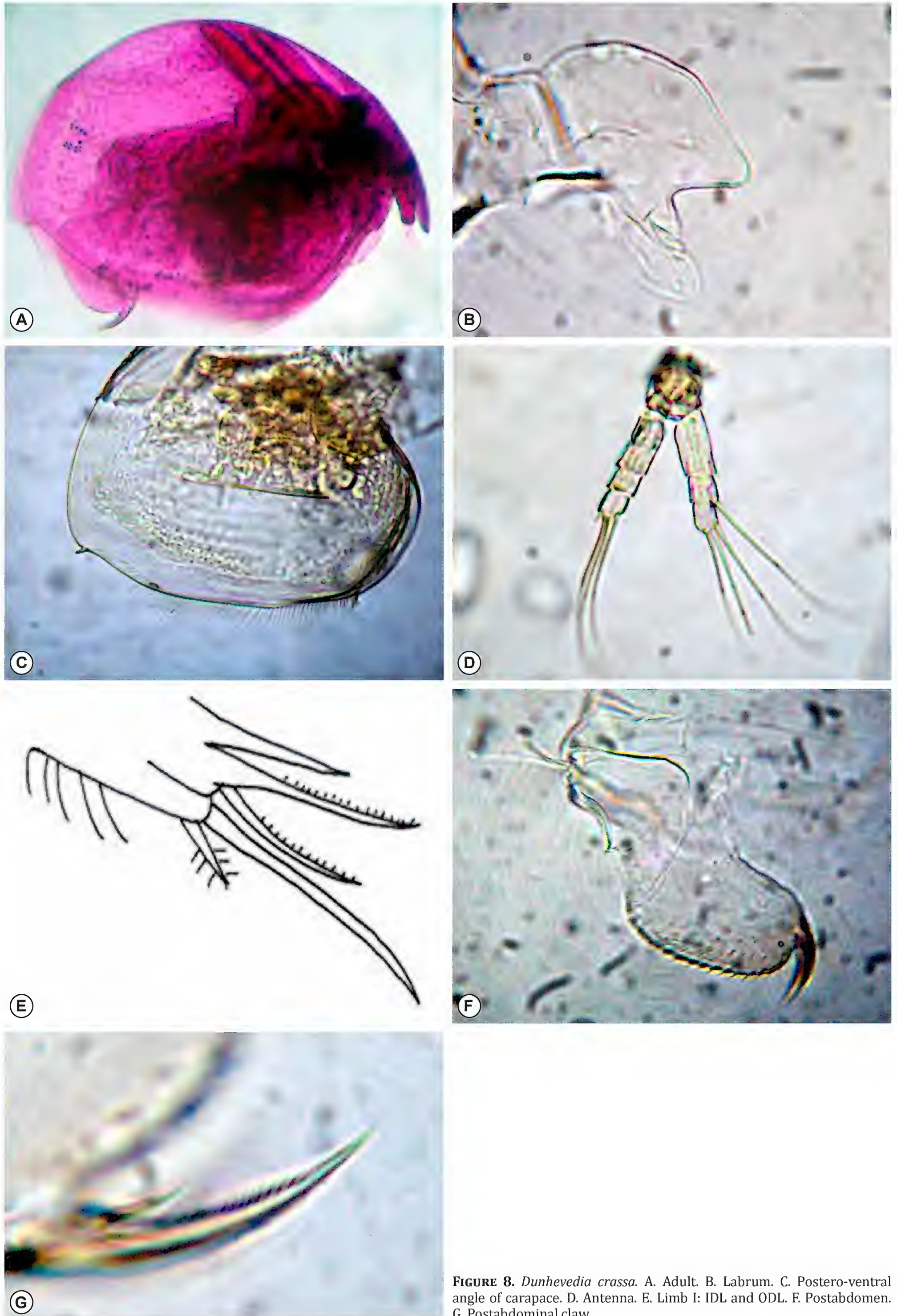


FIGURE 8. *Dunhevedia crassa*. A. Adult. B. Labrum. C. Postero-ventral angle of carapace. D. Antenna. E. Limb I: IDL and ODL. F. Postabdomen. G. Postabdominal claw.

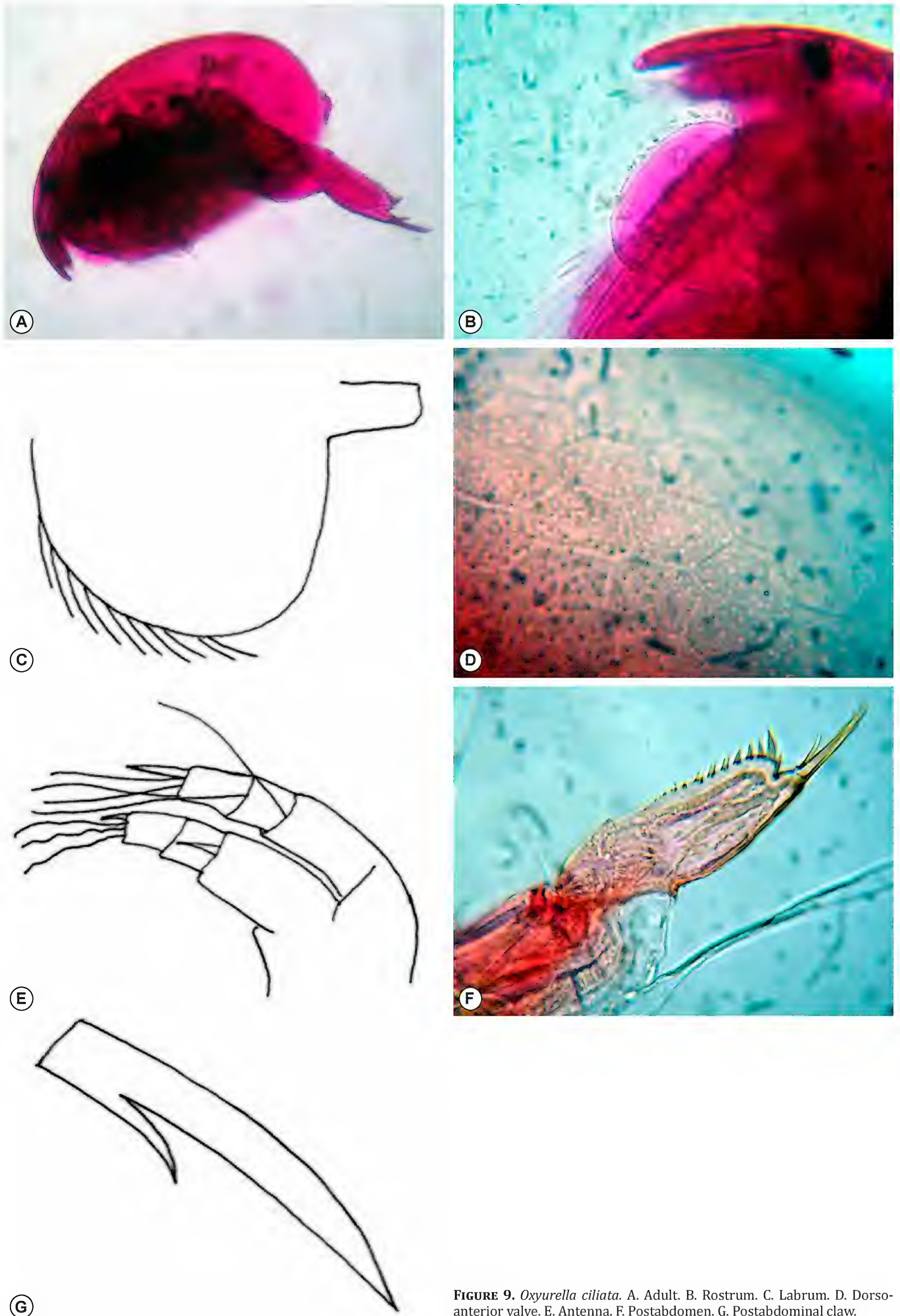


FIGURE 9. *Oxyurella ciliata*. A. Adult. B. Rostrum. C. Labrum. D. Dorso-anterior valve. E. Antenna. F. Postabdomen. G. Postabdominal claw.

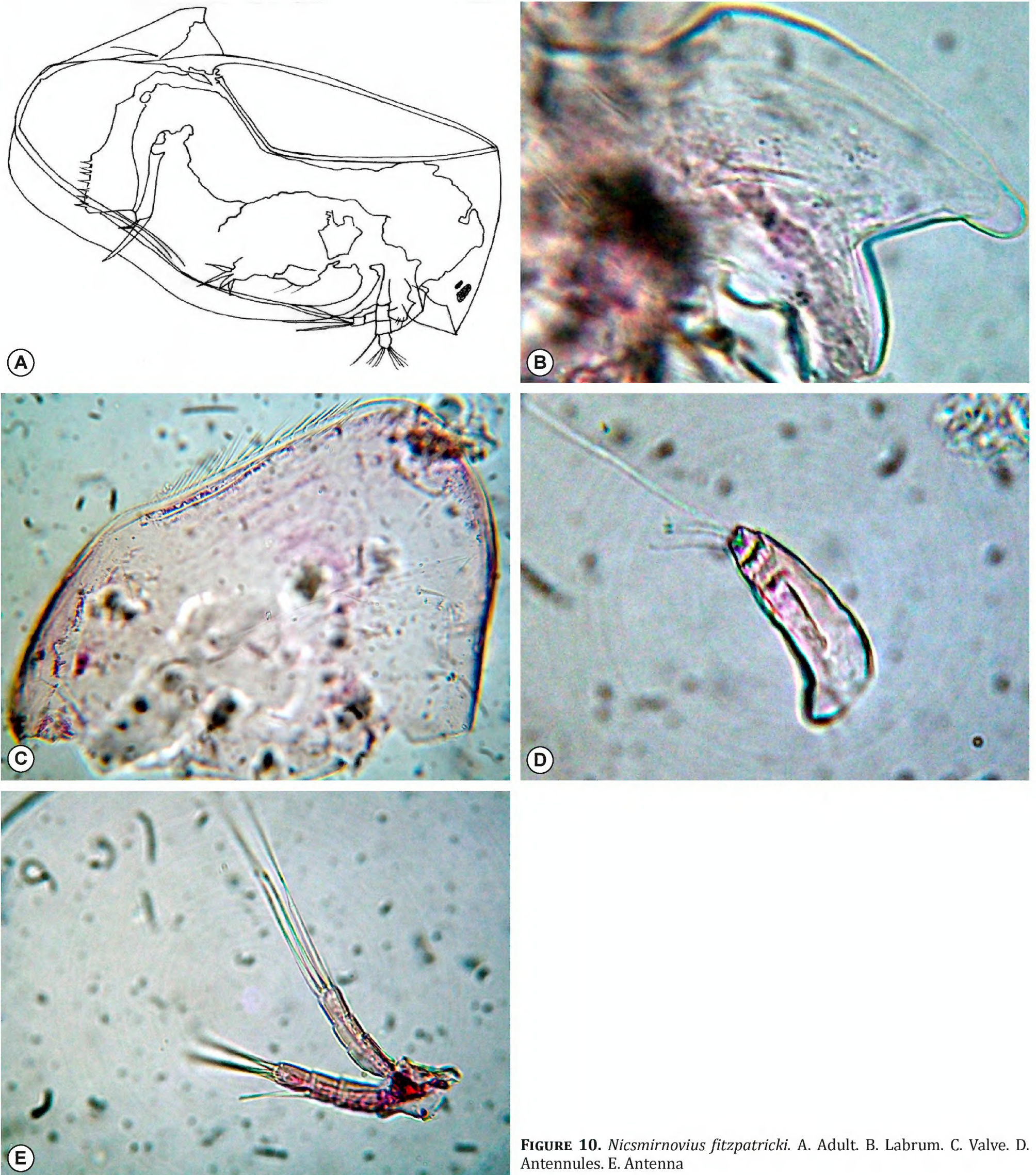


FIGURE 10. *Nicsmirnovius fitzpatricki*. A. Adult. B. Labrum. C. Valve. D. Antennules. E. Antenna



FIGURE 11. *Nicsmirnovius fitzpatricki*. A. Limb I: IDL and ODL. B. Postabdomen. C. Distal margin of postabdomen. D. Postabdominal Claw.

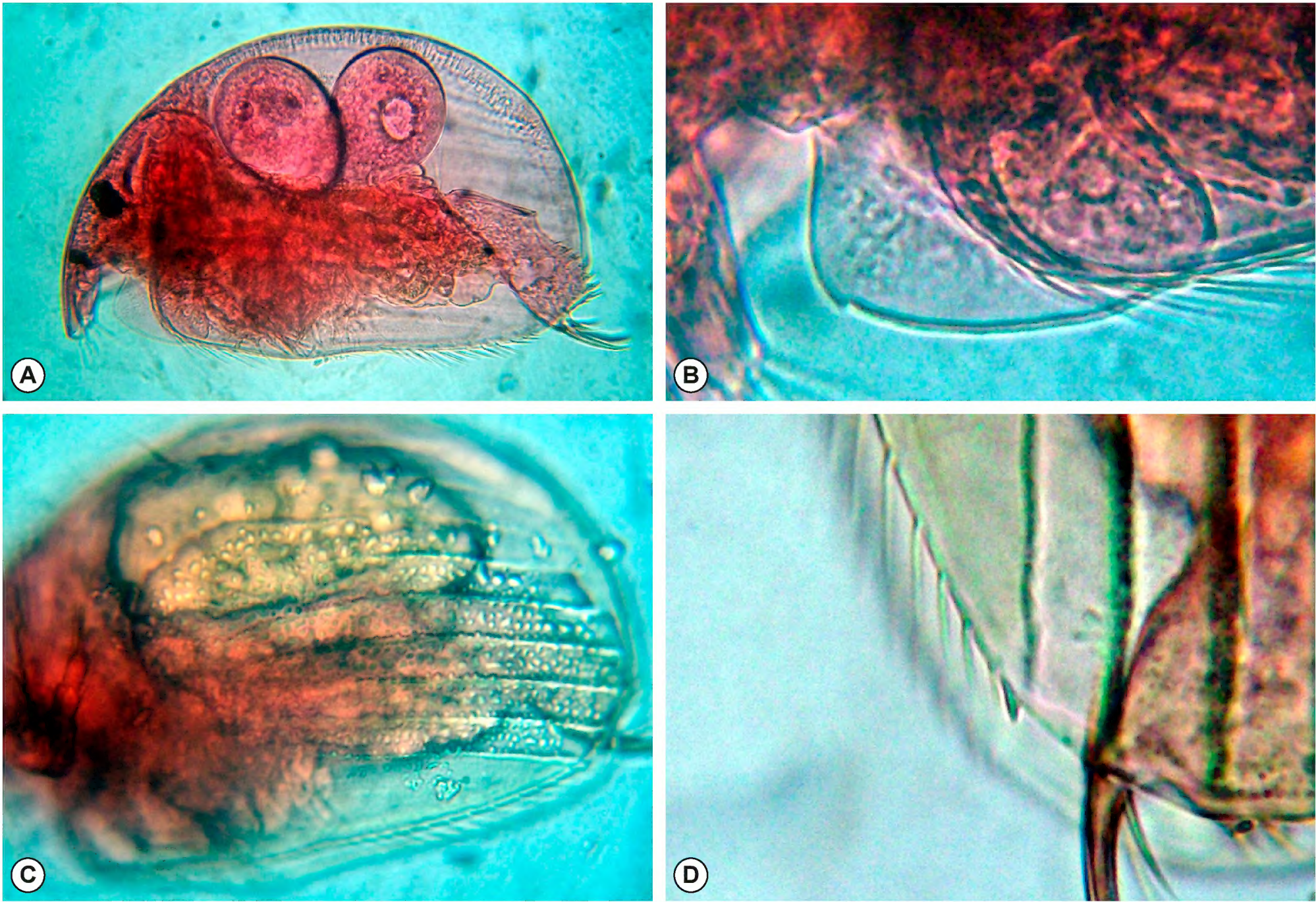


FIGURE 12. *Coronatella monacantha*. A. Adult. B. Labrum. C. Valve. D. Denticle of valve.

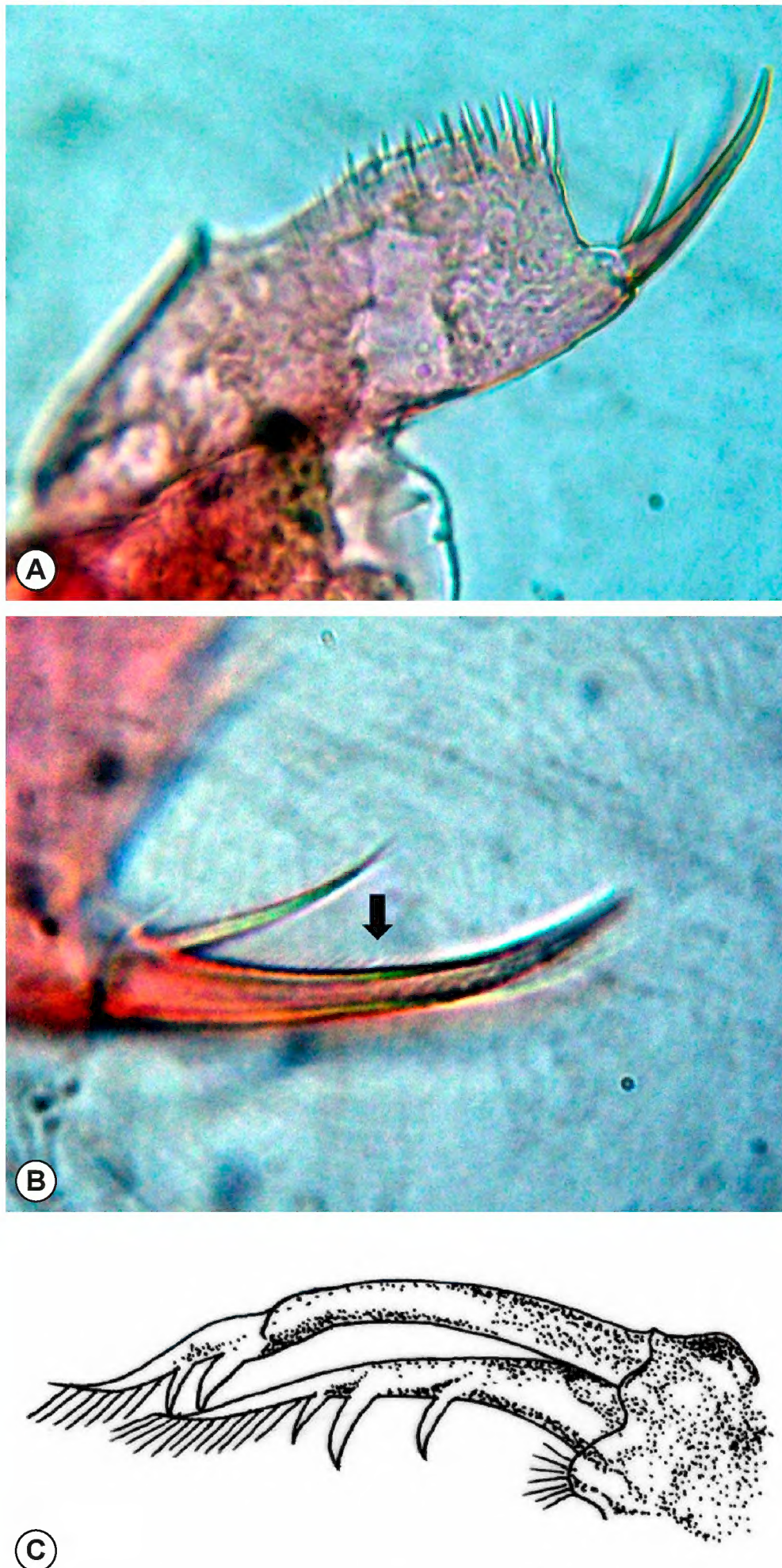


FIGURE 13. *Coronatella monacantha*. A. Postabdomen. B. Postabdominal claw (The arrow points at fine pectens). C. IDL of trunk limb I.

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